

Name _____ Rec. Instr. _____
Signature _____ Rec. Time _____

Math 220
Final Exam
May 10, 2023
6:20-8:10 PM

No books, calculators, or notes are allowed. Please make sure that your cell phone is turned off. You will have 110 minutes to complete the exam. Unless instructed otherwise, **show your work.**

Problem	Points	Points Possible	Problem	Points	Points Possible
1		15	8		6
2		18	9		6
3		5	10		5
4		5	11		6
5		6	12		6
6		4	13		6
7		6	14		6

Total Score:

1. (3 points each) Evaluate the following. You do not need to simplify your final answers.

A. $\lim_{x \rightarrow \infty} \frac{-3x - 9e^x}{7x + 2e^x} =$

B. $\int \left(\frac{2}{t^3} + 2\sqrt{t} \right) dt =$

C. $\frac{d}{dx} \int_x^2 \cos(e^t) dt =$

D. $\frac{d}{dx} \left(\frac{\tan(x^2)}{\cos(x) + x^3} \right) =$

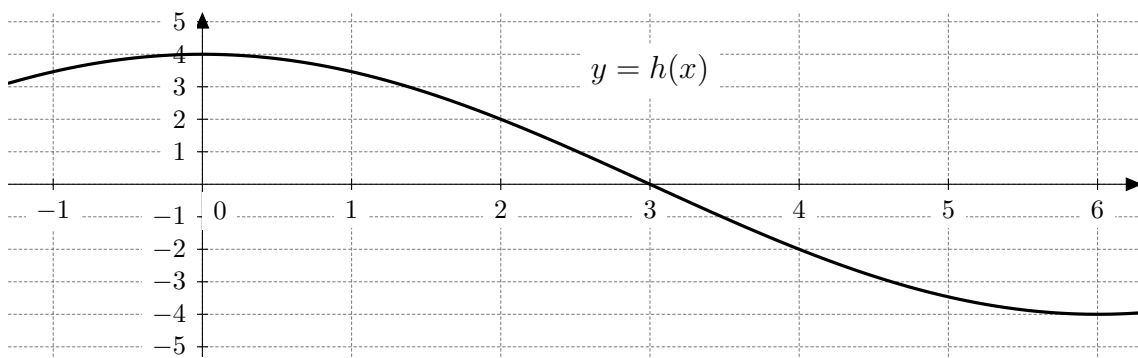
E. $\frac{d}{dx} (\ln(x) \cdot \arctan(x^3)) =$

2. (6 points each) Find the following:

A. $\int_3^4 x\sqrt{x-3} \, dx$

B. $\frac{dy}{dx}$ if $x^3 + y^3 = 5 - xy$

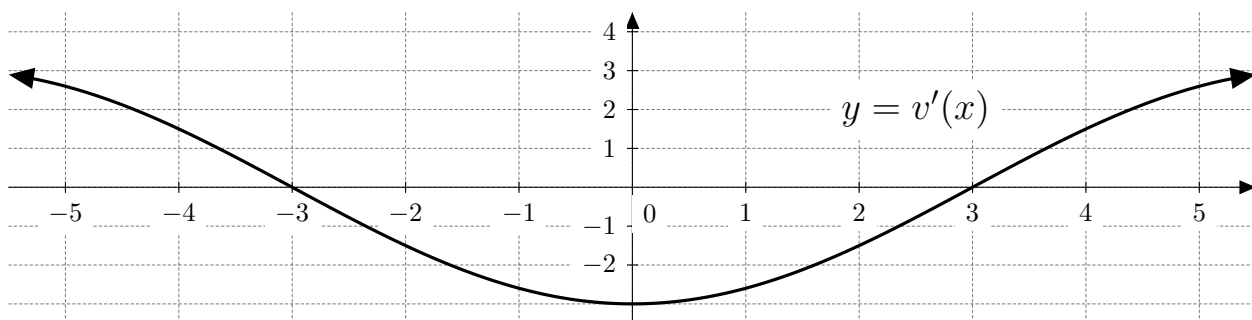
C. $k'(x)$ if $k(x) = x^{\sin(x)}$



3. (5 points) $y = h(x)$ is plotted above. Estimate $\int_0^6 h(x) dx$ by using a Riemann sum with $n = 3$ subintervals, taking the sampling points to be left endpoints (the Left-Endpoint Approximation L_3). Also, illustrate the rectangles on the graph above.

4. (5 points) Find $f(x)$ if $f'(x) = \cos(x) + 2$ and $f(0) = 5$.

5. (6 points) Find the area between the curves $y = 4$ and $y = x^2$.



6. (1 point each) $y = v'(x)$ is plotted above. Find:

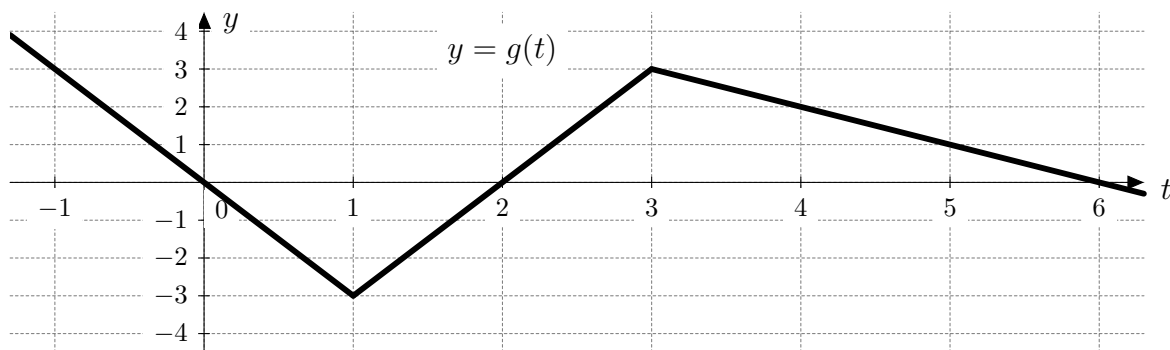
A. Interval(s) where $v(x)$ is increasing: _____ decreasing: _____

B. x -coordinate(s) where $v(x)$ has a local max: _____ local min: _____

C. Interval(s) where $v(x)$ is concave up: _____ concave down: _____

D. x -coordinate(s) where $v(x)$ has an inflection point: _____

7. (6 points) Let $p(x) = 75 - x^2$ be the price in dollars per meal that a chef can charge if they sell x meals. Revenue is the total amount of money received from the sale of x meals. Find the meal price that will maximize revenue? (Make sure to justify why your answer corresponds to the absolute maximum.)

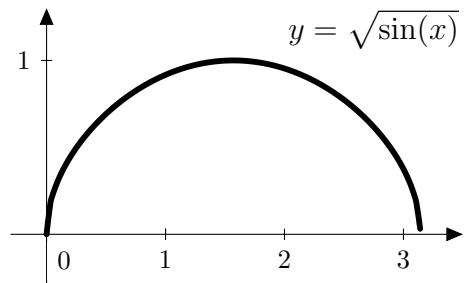


8. (3 points each) $y = g(t)$ is plotted above. Let $A(x) = \int_0^x g(t) dt$. Find the following quantities.

A. $A(3) =$

B. $A'(1) =$

9. (6 points) Find the volume of the solid obtained by rotating the region bounded by $y = \sqrt{\sin(x)}$ and $y = 0$ between $x = 0$ and $x = \pi$ around the x -axis.



10. (5 points) Use the linearization of $u(x) = \sqrt{x}$ at $x = 25$ to approximate $\sqrt{24}$.
11. (6 points) Using the **limit definition of the derivative**, find $f'(2)$ if $f(x) = x^2 + 5x$.
12. (6 points) Suppose that a particle has position $s(t)$ feet at time t seconds and a velocity function $s'(t) = t \cdot e^{-t^2}$ ft/s. Find the displacement (change in position) from time $t = 0$ seconds to time $t = 1$ second. (Include units with your answer.)

13. (6 points) Find the absolute minimum and absolute maximum of $w(x) = x^3 - 3x + 2$ on the interval $[0, 2]$.

14. (6 points) Boyle's Law states that when a sample of gas is compressed at a constant temperature, the pressure P and the volume V satisfy the equation $PV = C$, where C is a constant. Suppose that at a certain instant, the volume is 40 cm^3 , the pressure is 100 kPa , and the pressure is increasing at a rate of 20 kPa/min . At what rate is the volume changing at this instant? (Include units with your answer.)